

# Laparoscopic Versus Open Appendectomy: the Risk of Postoperative Infectious Complications

Muhammad Najm Khan, FCPS, FRCS (Glasg.), Tony Fayyad, MD,  
Tom D. Cecil, MD, FRCS, Brendan J. Moran, MD, FRCS

## ABSTRACT

**Background:** Despite the reported advantages of laparoscopic appendectomy (LA), ongoing debate exists about a possible increase in postoperative infectious complication rates especially intraabdominal infections and wound infection, unless wound protection is utilized.

**Methods:** All consecutive appendicectomies (open and laparoscopic) performed over 4 months were included in this prospective study. Demographic details, operative time, time to conversion, infective postoperative complications, and delay in discharge were recorded. The patients were divided into 2 groups, laparoscopic (LA) and open appendectomy (OA).

**Results:** A total of 134 appendicectomies were performed, 80 in the LA group and 54 in the OA group. Twenty-six (19.4%) appendices were perforated at the time of operation. The median patient age was 24 years (range, 7 to 63). Patients included 71 females and 63 males. Operating time in the LA group was longer with a median duration of 51.3 minutes (range, 35 to 100) compared with 40.6 minutes (range, 30 to 95) in the OA group. An extraction bag was used in 59/71 (83%) LA patients. Wound infection was recorded in 6 patients (5/54 in OA and 1/80 in LA). The site of wound infection was the port of specimen extraction in the laparoscopic group, and an extraction bag was not used. Wound infection delayed hospital discharge by an average of 2 days. Intraabdominal abscess formation complicated the outcome in 2 patients (1 in the LA group and 1 in the OA group).

**Conclusion:** Wound infection is less common in LA than in OA, and an extraction bag is recommended. Intraab-

dominal infection rates do not appear to be increased, though the numbers in this study are relatively small. The longer operating time is minimal given the better results, and LA is the optimal approach to the diagnosis and management of acute appendicitis.

**Key Words:** Appendectomy, Laparoscopic surgery, Wound infection, Intraabdominal abscess.

## INTRODUCTION

Laparoscopic surgery has gained in popularity and found application in almost every surgical speciality. The first experimental laparoscopy was performed by Dr. George Kelling in 1901 in a dog. He used a cystoscope to peer into the abdomen of a dog after first insufflating the peritoneal cavity with air. Since then, laparoscopic surgery has progressed in practically all branches of surgery with ever-increasing extensions of the boundaries to the most complex surgical procedures in select cases.

The management of many diseases has benefited from the application of the laparoscopic approach. Laparoscopic appendectomy is one such procedure increasing in popularity since initially reported by Semm in 1983.<sup>1</sup> Several studies have shown the advantages of laparoscopic surgery in terms of shorter hospital stay, rapid postoperative recovery, and better pain control.<sup>2-4</sup> However, there have been concerns about the risk of infectious complications, particularly the development of intraabdominal abscess and superficial wound infection. This risk is significantly increased in cases of perforated appendicitis.<sup>5,6</sup>

The purpose of this study was to assess the comparative incidence of superficial wound infection and intraabdominal abscess in patients undergoing appendectomy by open or laparoscopic surgery for suspected acute appendicitis.

## METHODS

This prospective comparative study was carried out in a district general hospital. All consecutive patients admitted with right iliac fossa pain who had an open or laparo-

Colorectal Surgery, Royal Hampshire County Hospital, Hampshire, UK (Mr Khan).

General Surgery, North Hampshire Hospital, Hampshire, UK (Dr Fayyad).

North Hampshire Hospital, Hampshire, UK (Dr Cecil).

North Hampshire Hospital, Hampshire, UK (Dr Moran).

Presented as an oral presentation at the 10th World Congress of Endoscopic Surgery, Berlin, Germany, September 13-16, 2006.

Address reprint requests to: Muhammad Najm Khan, FCPS, FRCS (Glasg.), Specialist registrar, Colorectal surgery, Royal Hampshire County Hospital, Romsey Road, Winchester, SO22 5DG, Hampshire, UK.

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scopic appendectomy as an emergency were included. No randomization was carried out. The choice between open and laparoscopic approach was decided by the operating surgeon after discussion with the patient.

Data were collected in a specifically designed ProForma, where the patient demographic details, operative findings, conversion to open surgery, and postoperative complications were recorded. Operative time and hospital stay were recorded. The main emphasis was on the development of infectious complications, ie, wound infection and intraabdominal abscess formation. CDC definitions of nosocomial surgical site infections were used for the purpose of defining wound infection.<sup>7</sup> They are shown in **Table 1**. Intraabdominal abscesses were diagnosed with ultrasound scan, CT scan, or both of these, in patients with suspected symptoms and signs. Patients were divided into 2 groups, Laparoscopic (LA) and Open (OA). The chi-square test was used for statistical analysis. A P value of <0.05 was considered statistically significant.

A standard technique for laparoscopic appendectomy was used with a 10-mm optical trocar in the infra-umbilical position. The Hasson technique was used for establishing pneumoperitoneum. Two 5-mm ports were used, one in the left iliac fossa and the other in the suprapubic position. Tripolar cutting forceps (ACMI Corporation, Southborough, MA, USA) were routinely used for dissection, as they helped to speed up the procedure. The appendix base was tied and divided between 2 endo-loops (Ethicon, UK) with laparoscopic scissors. An extraction bag

was used in 59/71 laparoscopic cases. The appendicular stump was not buried routinely. In the case of perforation, a careful washout was performed.

Open appendectomy was performed through a gridiron incision in the right iliac fossa by muscle splitting and peritoneal incision. The appendix was divided at the base, and the stump was gently buried. The wound was closed in layers. In patients with a perforated appendix, peritoneal wash out with normal saline was performed.

The severity of appendicitis was graded perioperatively as:

1-catarrhal when the appendix was inflamed without necrosis or perforation,

2-gangrenous when tissue necrosis was present,

3-perforated when a visible perforation was in the appendix with free pus.

All patients had prophylactic antibiotics at induction (cefuroxime 1.5 g and metronidazole 500 mg). Patients with catarrhal appendicitis had 3 further doses, and those with a gangrenous or perforated appendix had a 5-day course of antibiotics.

## RESULTS

This study included 134 patients. There were 63 males and 71 females with a median age of 24 years (range, 7 to 63). Of these 134 patients, 85 (63.4%) had acute appendicitis, 27/134 (20.1%) appendices were perforated, and 22/134 (16.4%) were normal on histological examination. There were 80 patients in the LA group and 54 in the OA group; however, 9 patients had a conversion to an open procedure. The distribution of cases among these groups is shown in **Table 2**.

The median operating time was 51.3 minutes (range, 35 to 100) for the laparoscopic group and 40.6 minutes (range, 30 to 95) for the open group. **Figure 1** shows a comparative graph for the median operating times between the 2 groups. There was one (1.2%) superficial wound infection in the laparoscopic group. There were 5 wound infections (9.2%) in the open group (P=0.05).

Grades of appendicitis were similar in the 2 groups though more perforated appendices occurred in the open surgery group. In the LA group, there were 53 inflamed appendices, 12 perforated appendices, and 15 normal appendices. In the OA group, 32 inflamed, 15 perforated, and 7 normal appendices were removed.

One patient in the open group and one in the LA group

**Table 1.**

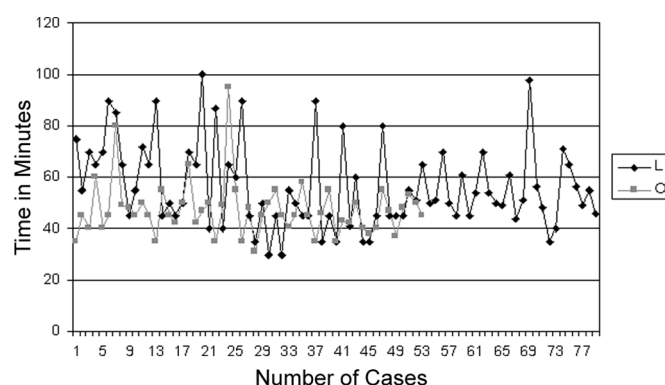
Criteria for Superficial Incisional Surgical Site Infection<sup>7</sup>

- I. Infection occurs within 30 days after the procedure, and infection involves only skin or subcutaneous tissue of the incision.
- II. At least one of the following:
  1. Purulent drainage, with or without laboratory confirmation, from the superficial incision.
  2. Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.
  3. At least one of the following signs or symptoms of infection
    - a. pain or tenderness
    - b. localized swelling,
    - c. redness
    - d. heat
  4. Diagnosis of superficial incisional SSI by the surgeon or attending physician

**Table 2.**

Demographic Details and Main Outcome Measures for Laparoscopic Appendectomy and Open Appendectomy

Demographics	Laparoscopic (n = 80)	Open (n = 54)
Age	24 (range, 10 to 63)	23 (range, 7 to 63)
Sex (M:F)	28:52	35:19
Severity		
Acute appendicitis	53	32
Perforated appendix	12	15
Normal appendix	15	07
Median operating time (minutes)	51.3 (range, 35 to 100)	40.6 (range, 30 to 95)
Conversion	9	
Wound infection	1	5
Intraabdominal abscess	1	1



**Figure 1.** Comparison of operative time between the laparoscopic (LA) and open appendectomy (OA) groups.

developed an intraabdominal abscess ( $P=0.48$ ). Conversion to an open procedure was necessary in 11% (9/80) of the patients in the laparoscopic group. The reasons for conversion are summarized in **Table 3**. Surgery was performed by 3 consultants and 6 specialist registrars.

**Table 3.**

Causes of Conversion in Laparoscopic Appendectomy

Cause	No. of Cases
Failure to progress	3
Gangrenous base of appendix	2
Adhesions	2
Intraoperative bleeding	2

## DISCUSSION

Appendectomy for acute appendicitis is a common emergency surgical procedure.<sup>8</sup> Open appendectomy has been the gold standard treatment for acute appendicitis since the description by Mc Burney in 1894.<sup>9</sup> Although appendectomy is considered a safe operation, a potential for complications exists. Most noticeable among them are wound infection, intraabdominal abscess, adhesions, bowel obstruction, and pulmonary complications from general anaesthesia.<sup>10</sup>

Since its first description in 1983, laparoscopic appendectomy has gained in popularity<sup>1</sup> with accumulating evidence demonstrating the benefits of the laparoscopic approach in terms of shorter hospital stay, more rapid recovery, and better postoperative pain control.<sup>11,12</sup> Furthermore, laparoscopy allows a complete and thorough assessment of the abdominal cavity and increases diagnostic accuracy, particularly in females where the rates of appendectomy with normal histology have been very high.<sup>13</sup>

The development of a postoperative intraabdominal abscess (IAA) after appendectomy is a rare but serious complication and is associated with significant morbidity.<sup>14</sup> Some reports<sup>15,16</sup> have suggested an increased risk of an intraabdominal abscess after laparoscopic appendectomy compared with open surgery, whilst others have reported the opposite.<sup>17</sup>

In this study, there was no difference, in that one patient in the open group and one in the LA group developed an intraabdominal abscess. Both were diagnosed by ultrasound scan at day 12 and 15 after their operation and were managed conservatively using broad-spectrum antibiotics

initially. One patient went on to require CT-guided drainage. Both patients made a full recovery.

Good surgical technique and proper use of antibiotics is crucial to reduce the incidence of postoperative intraabdominal abscess.<sup>14</sup> Surgeons experienced in the laparoscopic technique and beyond their learning curve report low rates of infectious complications.<sup>18</sup> The conversion rate in this study was 11%, similar to conversion in other reports,<sup>19,20</sup> though this decreases with increasing surgeon experience.

Tate<sup>21</sup> reported an incidence of 1.4% for the development of intraabdominal abscess following appendectomy, though this includes an incidence of 7.5% after surgery for perforated appendicitis. The higher incidence in perforated appendicitis may be due to increased bacterial contamination with a risk of a loose fecalith acting as a nidus for infection.<sup>22</sup>

An advantage of laparoscopic appendectomy has been the reduced risk of wound infection, as the inflamed appendix is dissected and removed without direct contact with the wound,<sup>21</sup> especially if an extraction bag for specimen retrieval is used.

This study has limitations. Patients were not randomized, and the choice of procedure was operator dependent. This introduces a bias in that the surgeons with experience and special interest in laparoscopic surgery were more likely to opt for the laparoscopic approach. Surgery was performed by varying grades of surgeons including 3 consultants and 6 specialist registrars. The incidence of intraabdominal abscess formation was low, and to detect a significant difference between the 2 groups would require a large number of patients in a randomized controlled trial. Due to other advantages of laparoscopic appendectomy, such a trial is unlikely.

In this study, the risk of superficial wound infection is less in the LA group and comparable to that in previous publications.<sup>23,24</sup> A postoperative intraabdominal abscess is a rare, though potentially serious, complication of the procedure, and this study suggests that the risks after laparoscopic and open appendectomy are similar.

## CONCLUSION

The advantages of diagnostic laparoscopy in patients with abdominal pain, combined with the benefits of laparoscopic appendectomy, suggest that all patients with suspected appendicitis should be considered for laparo-

scopic appendectomy provided appropriately trained personnel and adequate equipment are available.

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